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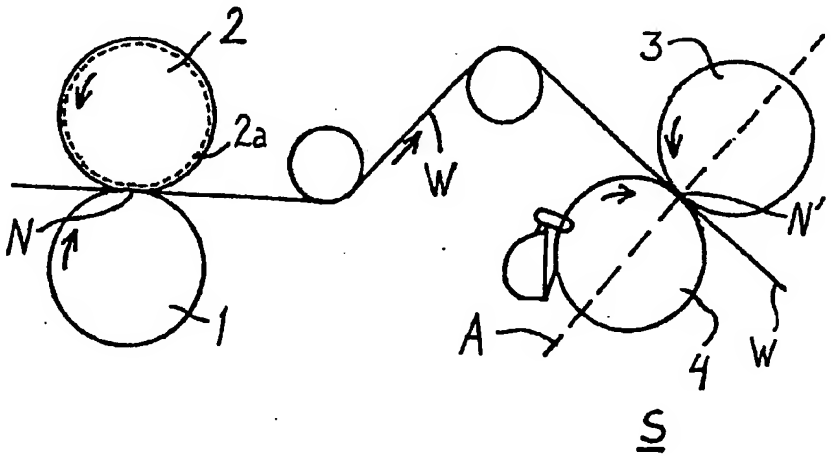
(54) Title: CALENDERING METHOD ESPECIALLY FOR PRECALENDERING AND A CALENDER FOR IMPLEMENTING THE METHOD



(57) Abstract: In the calendering method especially for precalendering, a paper web (W) is guided through a calendering nip (N) formed between two surfaces, wherein in the nip heat is conducted on the surface of the web to be calendered and pressure is exerted thereon within a fixed length in the travel direction of the web (W). In the calendering a long calendering nip of at least 50 mm, advantageously at least 70 mm in length is used, in which calendering nip the paper is brought in contact with the surface of a heated calendering element, such as a roll (1), whose surface temperature is at least 200°C, for example between 200 and 300°C, and the inlet moisture of the paper exceeds 5 %, wherein the combined effect of the residence time of the web in the nip and the temperature of the surface in contact with the web (W) in the nip is utilized to produce a permanent deformation in the fibres on the surface of the paper. After calendering at least that side of the paper web (W), to which the combined effect of the temperature and residence time has been applied to attain a permanent deformation, is coated.

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Calendering method especially for precalendering and a calender for implementing the method

The invention relates to a calendering method especially for precalendering, in which method a paper web is guided through a calendering nip formed between two surfaces, wherein in the nip heat is conducted on the surface of the web to be calendered and pressure is exerted thereon within a fixed length in the travel direction of the paper web. The nip in question is a so-called long nip known as such which extends a fixed distance in the travel direction of the web.

After the paper has been dried, desired surface structure of the web is attained by means of a mechanical treatment applied to the surface, i.e. calendering. There are many calendering methods, but it is characteristic to all of them that the web is brought through one or more nips, which is/are formed between two surfaces, typically between rotating roll surfaces. The purpose of calendering is to improve the paper quality by pressing the paper into a particular standard final thickness and especially by smoothening its surface. In view of the coating of the paper at a later stage, the purpose of calendering is to bind loose particles on the surface and close the surface so that the coating layer would become even.

It is well known that by means of calendering it is possible to attain a desired quality, such as smoothness and gloss for the paper produced and processed at earlier stages. At the same time a fixed final density is attained for the paper. Thus, the calendering affects both the visual and structural properties of paper. On the other hand, it is possible to conduct the calendering as a pre-treatment so that the desired properties can be attained on the surface of the paper for a treatment to be conducted at the next stage, for example coating.

Normally, when paper is calendered the smoothening and glazing of its surface takes place at the expense of the thickness of paper. In the calender, linear load and/or nip pressure is/are used as a control variable, which determines the surface quality of the paper as well as the final thickness. Especially in paper grades whose basis weight is

low, it has been impossible to implement such calendering in which the thickness of paper would not be substantially reduced when the intended surface quality is pursued.

As was mentioned above, calendering is conducted by conveying the web through one or more nips which are formed between rotating rolls. The nip can also be formed between a rotating roll and a counter roll or a belt passed over a special shoe. There may be several nips, wherein it is possible to form a calender, a so-called multi-nip calender, of the rolls placed on top of each other, between which the nips are formed.

In the calendering the web is influenced by temperature and pressure. Heat is transferred on the surface of the web, typically through a hot contact surface guiding the web in contact therewith through the nip, for example via the hard metal surface of a calender roll. By using a soft coating at least on the surface of the second roll or by passing an elastic belt via this second roll or a special shoe element, it is possible to form a longer nip, a so-called long nip in the travel direction of the web by means of elements pressed against each other on both sides of the nip with a fixed force, in which nip the nip pressure produced by the mutual loading of the elements (pair of calender rolls or a calender roll and a shoe) is distributed over a longer area in the travel direction of the web. One example of a shoe calender is described in the international publication WO 99/28551.

The significance of temperature is also disclosed in the Finnish patent 74066 and the corresponding US patent 4,606,26 (temperature gradient calendering) as well as in the US patent 5,033,373. The international publication WO 99/67462 discloses primarily the precalendering of paperboard in a long nip, so that bulk is maintained. Temperature and moisture values are not specified in more detail in this publication.

One factor, in addition to temperature and pressure, by means of which it is also possible to affect the calendering result is the moisture content of the web before calendering. There are for example known methods for moistening the web for example on that side which enters in contact

with a hot surface in the calender nip. Such a method is known for example from the European patent 617165 in which by means of a belt passed over a counter roll it is also possible to keep the web within a fixed length against the shell surface of the hot roll.

It is possible to affect the length of the nip by the selection of the soft coating or the belt passed through the calender nip at linear loads which are generally used.

After calendering it is possible to finish the paper in another manner, wherein the process in question is precalendering. Typical finishing process that takes place after the calendering is coating, wherein coating colour is spread on the surface of the calendered paper by means of a suitable method. The coating colour is an aqueous mixture, which contains pigment that affects the optical properties of paper, as well as binder for fixing the pigment. By means of precalendering methods the aim is to attain a suitable surface of the paper for coating, primarily a smoother surface, and especially to produce a closed surface for the base paper. In present coating methods it is also possible to spread small amounts of coating composition evenly.

When precalendered paper is coated it has been noticed that problems are caused by the fact that the water used in the coating relaxes the changes produced in the paper in precalendering. The original shape of the fibres is restored and the fibres compressed in the calendering become "tubular" again. As a result of this the surface of paper tends to become rougher again in connection with coating. The same problem occurs in all surface finishing treatments which succeed the precalendering, and in which the surface of paper enters in contact with water, as for example in surface sizing. In finished paper the problem may also occur in connection with such printing processes in which the paper enters in contact with water, especially in offset printing. In principle, it is possible to make the surface smoother by increasing the linear load, i.e. by increasing the nip pressure, but in that case other properties of paper are lost, i.e. the bulk of paper will suffer.

The amount of relaxation of the fibres as well as the respective amount of the re-roughening can be adjusted to a certain extent for example by means of the dry matter content of the coating colour and the coating method, but this restricts the coating process and the re-roughening cannot be prevented entirely in any case. To prevent the roughening from affecting the surface properties of the coated paper, the amounts of coating agent have to be increased, which is not a desirable solution. The problem has occurred for example in base papers containing mostly mechanical pulp by means of which it is not possible to attain good coverage in the coating process with small amounts of coating agent. Other paper grades may face similar problems. On the other hand, the aim is to keep the coating amounts within fixed target values defined for example by the paper grade.

The purpose of the invention is to eliminate the aforementioned drawbacks and to improve the surface quality in precalendering wherein the coating amount, the composition of the coating agent and the coating process can be selected more freely in the coating process following the calendering. To attain this purpose, the method according to the invention is primarily characterized in what will be presented in the characterizing part of the appended claim 1.

The web is guided to the calendering nip in a suitably high inlet moisture, and it is passed through this calendering nip under a relatively low calendering pressure by utilizing the sufficiently long residence time with the hot surface of the nip attained by means of the long calendering nip as well as the sufficiently high temperature on this surface. When the moist web is brought in contact with the hot surface for a sufficiently long period of time, it is possible to raise the surface temperature of the web above the glass transition temperature of fibres, the T_g point, which is dependent on moisture. Thus, the surface of the web is brought to a state in which the plastic deformation of fibres is permanent. In that case it is sufficient that the deformation is produced in the fibres on the surface layer of the paper, the roughening caused by the relaxation of the same having been the cause of problems, and the fibres in the middle in the z-direction may be left unaffected, wherein the bulkiness of paper is maintained. The fibres in the middle

of the paper may also undergo deformation, especially in thin paper grades, and bulk is lost at this stage, but because of the good surface quality it is possible to use lower pressure than usual in the calendering after the coating, wherein bulk is saved as a whole. In the final calendering of coated papers it is then possible to use for example a 2-nip soft calender with high surface temperature instead of a multi-nip calender.

It has to be noted that the surface temperature of the hot roll must be above the glass transition temperature so that the surface fibres can be brought to the glass transition temperature. The surface temperature of the surface which is in contact with the web in the calender nip with a sufficiently long residence time is between 200 and 300 °C, advantageously over 250°C, wherein a sufficient effect is attained even at high machine speeds (with shorter residence times). The temperature can be for example between 250 and 300°C. For practical reasons it is not reasonable to keep the surface temperature at a temperature of over 300°C, but basically in the invention it is possible to use even temperatures of over 300°C. If two successive calender nips are used for the treatment of different sides, the second one advantageously has a higher temperature than the first one, because the lower moisture content in the second nip requires a higher temperature in order to reach the same deformation.

By means of a long nip it is possible to produce a small pressure and a long residence time, by means of which, on the other hand, it is possible to raise the temperature of the fibres to a high level. The inlet moisture of calendering and the calendering temperature constitute variables by means of which the calendering result relating to the surface quality can be adjusted so that it becomes suitable in view of coating either by means of one variable or both variables. It is, for example, possible to keep one of the variables constant and change the other to obtain a desired smoothness and density on the surface. High moisture level is advantageous also in that respect that after calendering the final moisture is not too low although a high temperature is used.

In addition to the precalendering of coated papers the method can also be used in such calendering which finishes the final surface quality of the product, i.e. in the final calendering of uncoated papers.

The calendering is conducted in the above-described manner for paper which is left or moistened to a moisture level higher than usual, wherein its moisture exceeds 5%. Furthermore, it is possible to dry the web after the calendering. Thus, the inlet moisture of the web to calendering is advantageously approximately 10 to 20%, and the roughness of paper attained in the calendering is lower than the target roughness. When the paper is dried to the final moisture after the calendering conducted in such high moisture, i.e. the web is dried even further after the drying which has already occurred inherently in the calendering, the surface of the paper is roughened to the desired level. When the paper is calendered by means of the combined effect of a high temperature, high moisture level and long residence time, the greatest tensions are relaxed and the original shape of the fibres is partly restored during the drying. Thus, the target roughness is reached, and the surface roughened by means of the drying process is not roughened anymore when it is exposed to the effect of water in the next process, for example in a coating process or printing process. Such a paper is less sensitive than paper calendered after the drying in moisture lower than the aforementioned values. The inlet moisture can also be selected in such a manner that by the used temperature and residence time and possibly by the effect of the number of the nips, the paper reaches the target moisture already in the calendering before coating, and it is not dried any further.

In the following, the invention will be described in more detail with reference to the appended drawings, in which

Fig. 1 shows schematically a calender nip used in the method according to the invention,

Fig. 2 shows the use of the invention in precalendering when the calendering is conducted only on one side,

Fig. 3 shows the use of the invention in two-sided precalendering,

Fig. 4 shows the use of the invention in precalendering according to a second embodiment,

Fig. 5 shows the use of the invention in final calendering when the calendering is conducted only on one side, and

Fig. 6 shows two-sided final calendering.

Fig. 1 shows schematically a calender nip N used in the invention. The nip is a so-called long nip which is produced when a hard-faced roll 1 that is arranged rotatable and a soft, elastic continuous material 2a are loaded against each other, which material can be the soft roll coating of a second, rotating calender roll, a belt passed over a stationary shoe element or a belt guided over a rotating counter roll. Thus, the shape of the nip is formed as a result of the combined effect of loading and the elasticity of the material. The length of the nip is at least 50 mm, advantageously at least 70 mm. The paper web W to be calendered is guided between the hard roll surface and the material 2a, wherein it travels a fixed distance under pressure in the nip N. The shell surface of the roll 1 and the material 2a move substantially at the speed of the web W. The pressure prevailing in the nip is determined by the mutual loading of the hard-faced roll 1 and the counter element (roll body of a soft-faced roll, counter roll or a shoe element) supporting/bearing the elastic material 2a, which can also be expressed as linear load (loading force/width of the paper web). In a known manner, the pressure varies in the longitudinal direction of the calender nip so that it is gradually increased to a maximum value, which is located approximately in the centre of the nip, and thereafter it is gradually reduced to the original pressure. By adjusting the shoe it is possible to change the pressure profile and the nip length.

The hard-faced roll 1 is a so-called thermo roll, which can be heated in a known manner so that the surface temperature rises so high that in the contact under nip pressure during a predetermined residence time dependent on the nip length produces a plastic deformation of the

fibres on the surface of the paper web W. By means of the long nip and high moisture content it is possible to influence the temperature of the fibres so that the temperature rises significantly above the glass transition temperatures of polymers contained in the fibres. For this purpose, the surface temperature T of the roll 1 when it enters the calender nip is advantageously at least 200°C, more advantageously at least 250°C.

The residence time of the web in the nip N is the length of the nip divided with the speed of the paper web. During this time the web is in a pressurized contact with the surface of the roll that is at a predetermined temperature, from which surface heat is transferred to the web. At present high machine speeds it is important to produce a sufficiently long nip, so that the web would be subjected to the effect of pressure and temperature for a sufficiently long time. By means of the geometry (shape and position) of the shoe element it is also possible to affect the pressure distribution in the long nip.

Fig. 2 illustrates the use of the invention in precalendering. The paper is calendered in the long nip N between the hard roll 1 and the soft-faced calendering element 2. In the figure, the soft-faced calendering element 2 is a rotating calender roll equipped with a soft roll coating, but it can also be formed of a belt in the shape of a roll shell, which is loaded from inside by means of a shoe element, wherein the calender is a so-called shoe calender, or it may be a combination of a rotating counter roll and a endless belt travelling over the same and through the nip. The inlet moisture of the web W to the nip N exceeds 5%. Besides promoting deformability, the high moisture content of the web prevents the web from excessive drying and suitable outlet moisture is attained for the web, for example moisture with the value of at least 3.0%.

When the web W has travelled through the calender nip N, the surface of the same has reached a state in which it is permanently plasticized. Thereafter the web W is guided to a process in which aqueous substance is spread on the surface of the same, especially to a coating process which is conducted in a coating unit S in which at least on the surface of the web which has been positioned against the hot surface in

precalendering and in which the deformation of the fibres is permanent, aqueous coating agent composition is spread, in the figure by means of film transfer coating by spreading a thin layer of coating agent evenly on the surface of the roll 4 and by transferring it in the nip N' between the rolls 3, 4 on the surface of the web. Other coating methods are also possible. The coating can also be surface-sizing in which aqueous surface sizing agent is spread on the surface of paper. Thereafter the paper is dried in a known manner and reeled in the reel-up. It is also possible to use other coating methods, such as blade coating.

Fig. 3 shows precalendering in which the web is precalendered before coating by subjecting both sides to the same treatment. In the first calendering unit C1 the web W is calendered in the long nip N between a hard roll 1 and a soft-faced calendering element 2. The second calendering unit C2 on that side of the web which had the soft-faced element now contains the hot surface, i.e. the order of the elements is changed. In the second nip a higher temperature than in the first one is advantageously used. Similarly, in two-sided treatment it is possible to use relatively high inlet moisture of calendering (e.g. approximately 20 %), because the web dries to a greater degree. The inlet moisture of the second nip can be approximately 10 %. After a two-sided treatment the web is coated on both sides in the coating unit S by means of rolls 3 and 4 in a film transfer coating operation. It is also possible to use other coating methods.

The effect in the calendering can be intensified by moistening the surface of the web. Fig. 4 shows a premoistening unit 7 located before the calender in the travel direction of the web, in which unit the web is moistened to a moisture level higher than usual. Thus, the moisture content of the web when it enters the calender nip N exceeds 5 %. It is possible to use known moistening devices which accurately portion a fixed amount of water on the surface of the web. If the web is moistened to a moisture content of approximately 10 to 20%, the roughening of the same can be reduced at later treatment stages by allowing it to roughen to the desired level in the drying after calendering. After the calender there is a drying unit 5 in which the drying of the web is conducted in such a manner that the surface is

roughened to the desired level. Although the figure shows a single multi-cylinder drying group in which the web is passed in contact with the hot-surfaced drying cylinders, it is also possible to utilize drying conducted by means of radiant heat for example by means of known infrared dryers, or a combination of both. The number of the drying cylinders can differ from that shown in the figure, and some of the cylinders may be unheated suction rolls. After the drying unit 5 the web is passed to a coating unit S which can be any of those described above, or the paper is printed in a printing process.

Premoistening is not necessary if the web is left to a suitably moist state in the preceding drying section. Thus, the moistening unit 7 can also be omitted. Furthermore, it is possible that in Fig. 4 the web is calendered on both sides similarly to Fig. 3.

The paper web W is dried in the calender depending on the residence time and the temperature. If the web is dried to a moisture level of approximately 5 to 8 %, it can be passed to the coating unit 3 without a drying stage therebetween. Alternatively, the web can be dried to this moisture level in the drying unit 5.

Fig. 5 illustrates the use of the invention in final calendering, and it differs from the preceding figures in that respect that the web is not subjected to a treatment after the calendering conducted according to the invention, but the web is reeled on reel in a reel-up. The quality of the surface of the paper is thus advantageous when the paper is used for printing purposes, wherein the water does not cause re-roughening in connection with the printing process. The treatment can be otherwise the same as the one shown in Fig. 2, i.e. high inlet moisture, long nip and high temperature.

Fig. 6 illustrates final calendering in which a 2-nip calender is used, wherein in the latter calender nip the hot surface enters within a suitable residence time in contact with the side of the web which in the preceding nip was left untreated, i.e. the thermo rolls 1 are positioned on different sides of the web. Thus, the arrangement is the same as in Fig. 3.

The calendering and possible premoistening can be conducted as an on-line process in the papermaking line, wherein the calender is positioned in the so-called dry end of the machine producing paper from fibrous pulp. It is also possible to conduct the calendering and coating in the same line as an off-line process for paper which has been produced in a different machine and thereafter reeled up. One possible alternative is also that the paper is reeled after the calendering, as in Figs 5 and 6, and this reeled paper, which thus has suitable surface properties as a result of calendering, is subjected to coating in a different coating unit as an off-line treatment with respect to the calendering.

The invention is especially well suited for precalendering of base papers containing mechanical pulp, for example for precalendering of LWC base papers, but the invention is also suitable for precalendering of other coated wood-containing and woodfree printing papers. Although the advantages of the invention are obvious especially when relatively lightly coated paper grades (LWC, ULWC) are produced, the invention is not restricted to the amount of coating, and it can also be used in paper grades with a thicker coating. The invention is also suitable for final calendering of uncoated printing papers.

In the following, the invention will also be described by means of examples which do not restrict the invention.

Base paper with a basis weight of 40 g/m^2, in which 35% of the fibres consisted of chemical pulp and 65% of mechanical pulp and whose filler content was 5% was subjected to precalendering tests by means of a soft calender with a hard roll and a soft-faced polymer roll as rolls forming a relatively short nip, and to second precalendering tests in a nip of 70 to 100 mm in length in a so-called shoe calender. The web speed was 1,000 m/min. The results are presented in the following table.

Table. Results of precalendering for 40g/m^2 base paper in soft calendering and long-nip calendering.

	Uncalendered base	Precalendering (soft/hard)			
Nip pressure (kN/m)		60	60	150	150
Surface temperature of the thermo roll (0°)		50	100	50	100
Density (kg/m^3)	585	685	691	721	731
Moisture content (%)	4,2	4,1	3,6	3,9	3,6
PPS roughness, ts/ws (µm)	6.26/8,17	6.20/5.65	6.15/5.52	6.07/5.08	5.90/5.12
Bendtsen smoothness, ts/ws (ml/min)	510/710	505/400	509/385	510/250	515/260
Bendtsen air permeability (ml/min)	250	241	235	231	221
Cobb-Unger oil absorption, ts/ws (g/m^2)	21.0/16.5	20.1/14.2	19.5/13.6	19.9/14.3	19.4/13.1
	Uncalendered base	Precalendering (long nip)			
Nip pressure (kN/m)		200	400	400	400
Surface temperature of the thermo roll (0°)		200	200	290	290
Density (kg/m^3)	585	645	691	743	746
Moisture content (%)	4,2	3,5	3	2,5	x
	10,1	x	x	x	4,5
PPS roughness, ts/ws (µm)	6.26/8.17	5.98/5.27	5.82/3.70	5.66/2.99	5.44/2.66
Bendtsen smoothness, ts/ws (ml/min)	510/710	505/230	440/198	425/191	408/198
Bendtsen air permeability (ml/min)	250	201	151	110	98
Cobb-Unger oil absorption, ts/ws (g/m^2)	21.0/16.5	19.4/13.5	17.9/11.6	16.1/8.2	15.1/6.5

On the basis of the results it can be said that the surface of the paper positioned against the thermo roll is made considerably more closed improved when the moisture content is increased over 10%, and the temperature is 200 to 300°C in calendering conducted with a long nip. The attained oil absorption on the bottom side (in the table ws, i.e. wire

side) positioned against the hot 290°C roll was 6.5 g/m^2, when the inlet moisture of calendering was 10.1 %

Claims:

1. A calendering method especially for precalendering, in which method a paper web (W) is guided through a calendering nip (N) formed between two surfaces, wherein in the nip heat is conducted on the surface of the web to be calendered and pressure is exerted thereon within a fixed length in the travel direction of the paper web, **characterized** in that in the calendering a long calendering nip of at least 50 mm, advantageously at least 70 mm in length is used, in which calendering nip the paper is brought in contact with the surface of a heated calendering element, such as a roll (1), whose surface temperature is at least 200°C, for example between 200 and 300°C, and the inlet moisture of the paper exceeds 5%, wherein the combined effect of the residence time of the web in the nip and the temperature of the surface in contact with the surface of the web (W) in the nip is utilized to produce a permanent deformation in the fibres on the surface of the paper.

2. The method according to claim 1, **characterized** in that the surface temperature is at least 250°C, preferably between 250 and 300°C.

3. The method according to claim 1 or 2, **characterized** in that after calendering at least that side of the paper web to which the combined effect of the temperature and residence time is applied to attain a permanent deformation is coated.

4. The method according to any of the preceding claims 1 to 3, **characterized** in that the paper web (W) is passed to calendering in moisture of 10 to 20%.

5. The method according to claim 4, **characterized** in that the paper web (W) is dried after calendering.

6. The method according to claim 4 or 5, **characterized** in that at least that side, to which the combined effect of the temperature and the residence time is applied to attain a permanent deformation, is coated.

7. The method according to claim 6, **characterized** in that the coating is conducted in the same line with the calendering.

8. The method according to any of the preceding claims, **characterized** in that both sides of the web are subjected to a corresponding treatment.

9. A treatment line for paper containing a calender for treating the surface of paper, and a coating unit for coating the surface of paper, **characterized** in that

- the calender comprises a nip area (N) of at least 50 mm, advantageously at least 70 mm in length in the travel direction of a paper web (W), which area is formed between the surface of a heated calendering element, such as a roll (1) and the surface (2a) of a second calendering element,
- in the travel direction of the web (W) after the calender a coating unit (S) comprising coating means (3, 4) which are arranged at least on that side of the web (W) which has been positioned against the surface of a heated calendering element, such as a roll (1)

10. The treatment line according to claim 9, **characterized** in that the calender comprises two calendering units (C1, C2), in which in the nip areas (N) the surfaces of the heated calendering elements, such as the surfaces of the roll (1) are positioned on different sides of the web, and in the travel direction of the web, after the calendering units (C1, C2) there are one or more coating units (S) which comprise means for conducting coating on both sides.

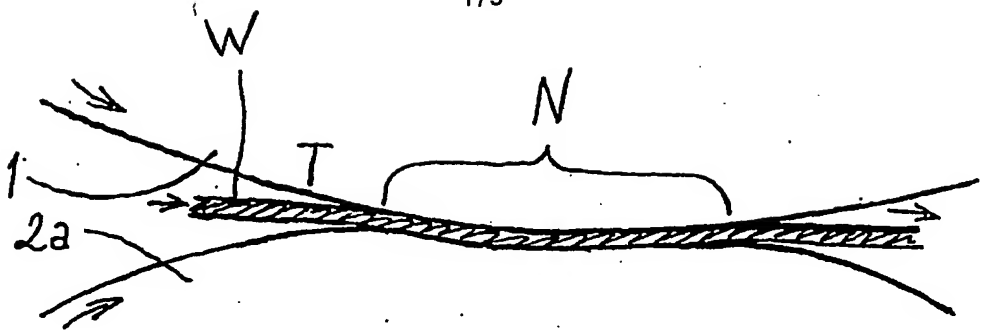

Fig. 1

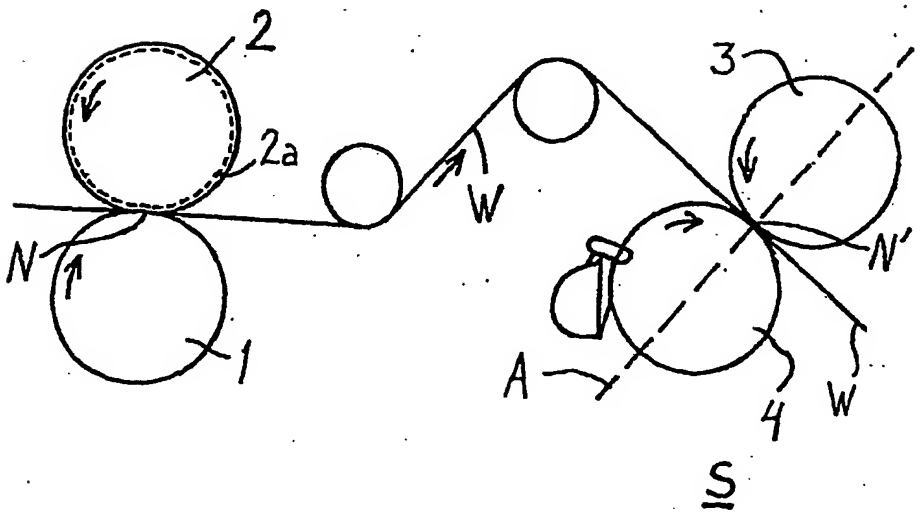

Fig. 2

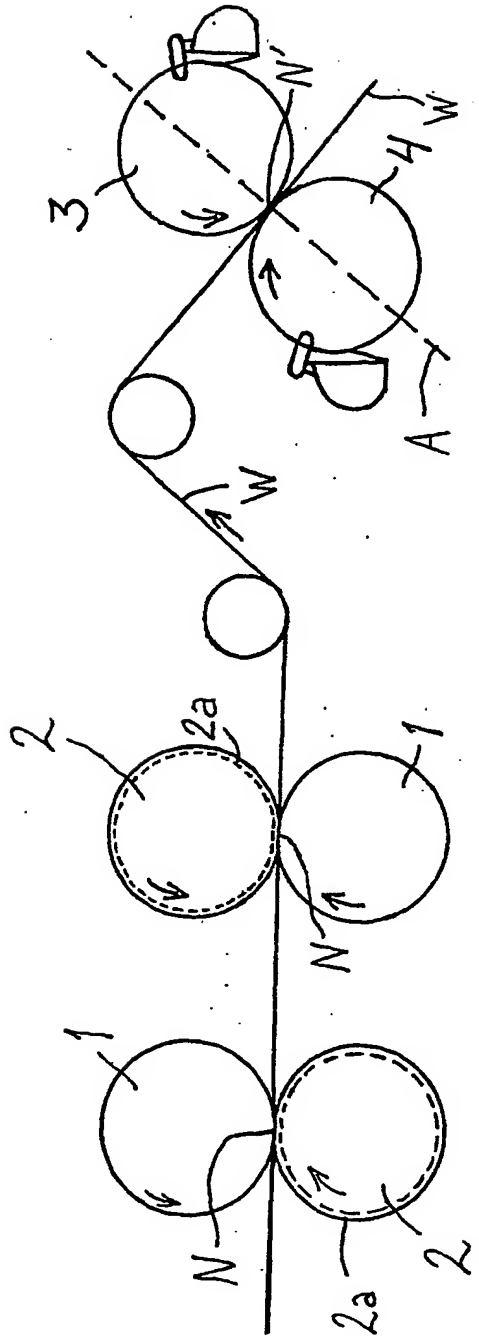

Fig. 3

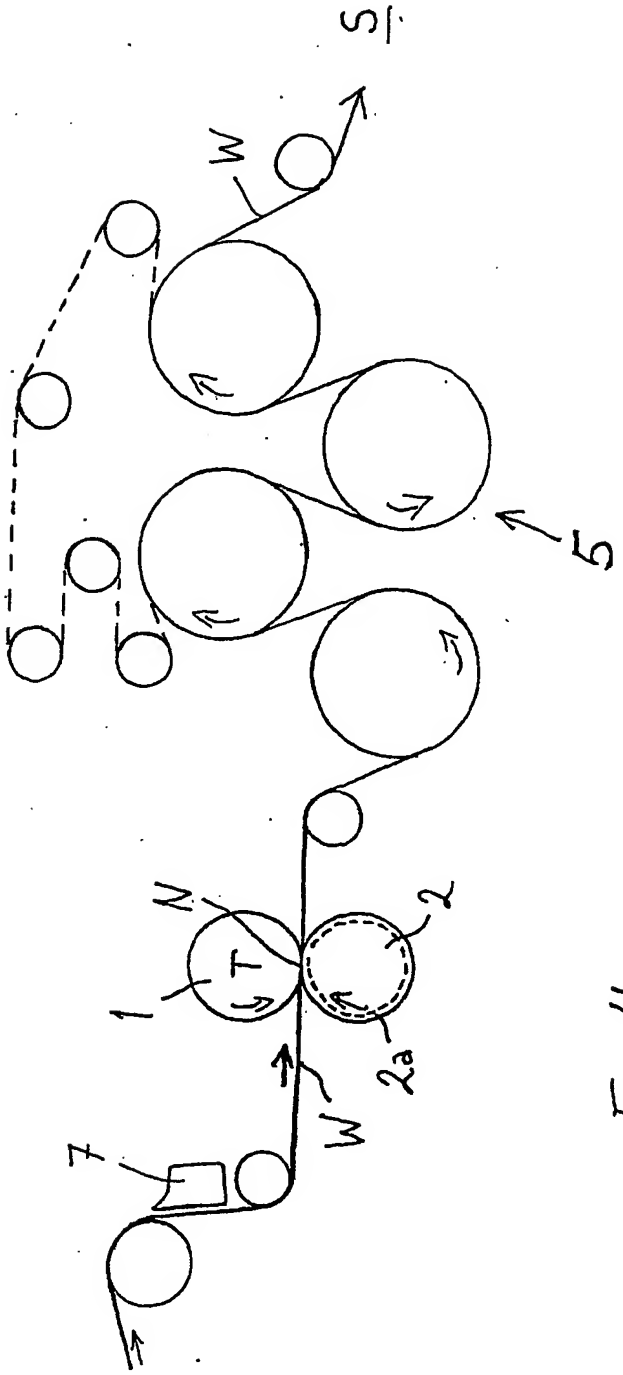

Fig. 4

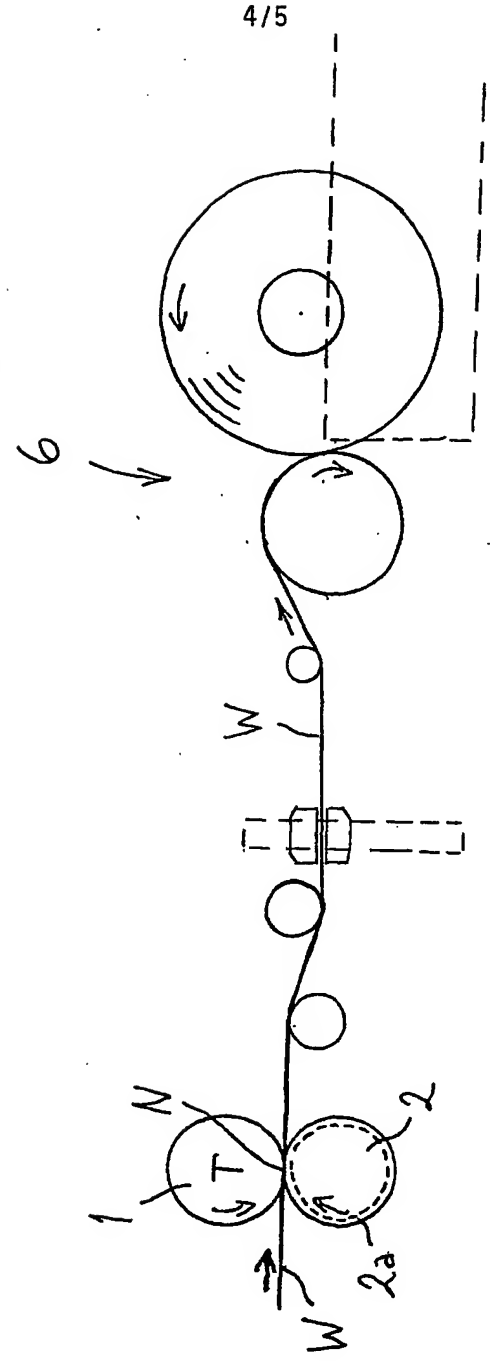

Fig. 5

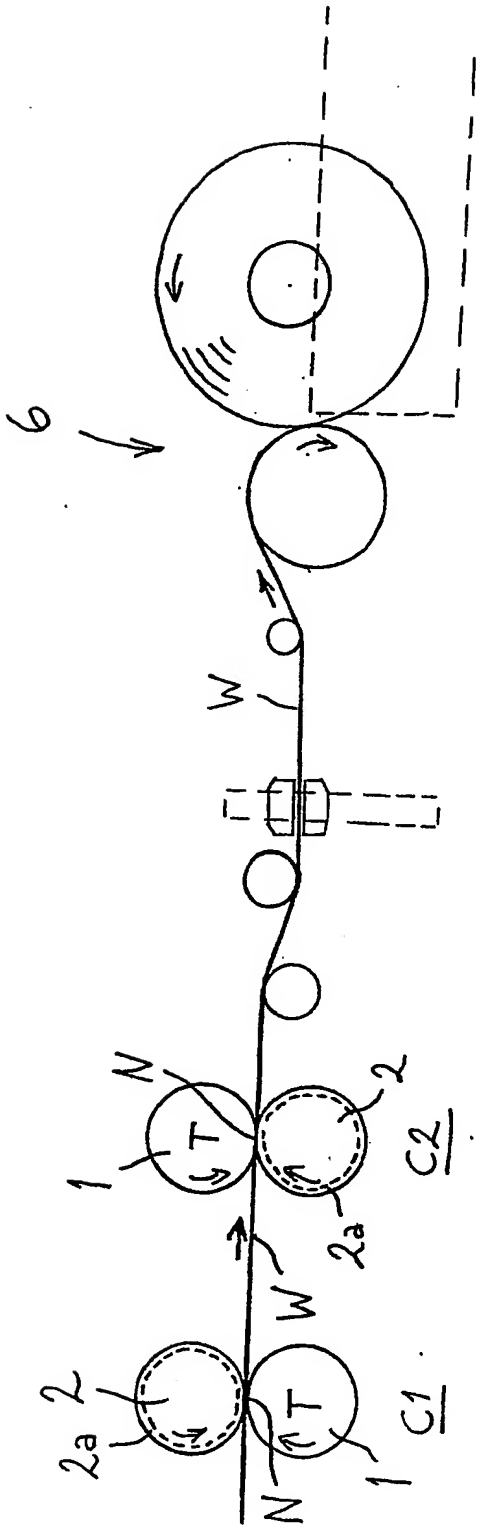

Fig. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 01/00595

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: D21G 1/00 // D21H 19/00
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: D21G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 9967462 A1 (VALMET CORPORATION), 29 December 1999 (29.12.99), page 6, line 9 - line 21; page 7, line 3 - line 10; page 7, line 25 - line 29	1-10
A	US 4624744 A (JAY H. VREELAND), 25 November 1986 (25.11.86), column 3, line 41 - line 43; column 5, line 17 - line 26; column 5, line 57 - line 62	1-10
A	US 4606264 A (RONALD D. AGRONIN ET AL), 19 August 1986 (19.08.86), column 6, line 30 - line 32	1-10

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
4 October 2001	12. 11. 01
Name and mailing address of the ISA: European Patent Office Facsimile No.	Authorized officer ERIKA WESTBERG/EÖ Telephone No.

INTERNATIONAL SEARCH REPORT

Information on patent family members

03/09/01

International application No.
PCT/FI 01/00595

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